CLAIMS

1. A method for forming a field-effect transistor on a substrate, said substrate including a high-k dielectric layer situated over said substrate and a gate electrode layer situated over said high-k dielectric layer, said method comprising steps of:

etching said gate electrode layer and said high-k dielectric layer to form a gate stack, said gate stack comprising a high-k dielectric segment situated over said substrate and a gate electrode segment situated over said high-k dielectric segment;

performing a nitridation process on said gate stack.

2. The method of claim 1 wherein said step of performing said nitridation process on said gate stack comprises utilizing a plasma to nitridate sidewalls of said gate stack, said plasma comprising nitrogen.

3. The method of claim 1 wherein said step of performing said nitridation process on said gate stack causes nitrogen to enter said high-k dielectric segment, said nitrogen forming an oxygen diffusion barrier in said high-k dielectric segment.

4. The method of claim 1 wherein said step of etching said gate electrode layer and said high-k dielectric layer to form said gate stack is performed in a process chamber, said process chamber being utilized to perform said step of performing said nitridation process on said gate stack.

5. The method of claim 1 wherein said step of etching said gate electrode layer and said high-k dielectric layer to form said gate stack is performed in a first process chamber and said step of performing said nitridation process on said gate stack is performed in a second process chamber.

6. The method of claim 1 wherein said high-k dielectric segment is selected from the group consisting of hafnium oxide, hafnium silicate, zirconium oxide, zirconium silicate, and aluminum oxide.

7. The method of claim 1 wherein said gate electrode segment comprises polysilicon.

8. A method for forming a field-effect transistor on a substrate, said substrate including a high-k dielectric layer situated over said substrate and a gate electrode layer situated over said high-k dielectric layer, said method comprising a step of etching said gate electrode layer and said high-k dielectric layer to form a gate stack, said gate stack comprising a high-k dielectric segment situated over said substrate and a gate electrode segment situated over said high-k dielectric segment, said method being characterized by:

performing a nitridation process on said gate stack.

9. The method of claim 8 wherein said step of performing said nitridation process on said gate stack comprises utilizing a plasma to nitridate sidewalls of said gate stack, said plasma comprising nitrogen.

10. The method of claim 8 wherein said step of performing said nitridation process on said gate stack causes nitrogen to enter said high-k dielectric segment, said nitrogen forming an oxygen diffusion barrier in said high-k dielectric segment.

11. The method of claim 8 wherein said step of etching said gate electrode layer and said high-k dielectric layer to form said gate stack is performed in a process chamber, said process chamber being utilized to perform said step of performing said nitridation process on said gate stack.

12. The method of claim 8 wherein said step of etching said gate electrode layer and said high-k dielectric layer to form said gate stack is performed in a first process chamber and said step of performing said nitridation process on said gate stack is performed in a second process chamber.

13. The method of claim 8 wherein said high-k dielectric segment is selected from the group consisting of hafnium oxide, hafnium silicate, zirconium oxide, zirconium silicate, and aluminum oxide.

14. The method of claim 8 wherein said gate electrode segment comprises polysilicon.

15. A method for forming a field-effect transistor on a substrate, said substrate including a high-k dielectric layer situated over said substrate and a gate electrode layer situated over said high-k dielectric layer, said method comprising steps of:

etching said gate electrode layer and said high-k dielectric layer to form a gate stack, said gate stack comprising a high-k dielectric segment situated over said substrate and a gate electrode segment situated over said high-k dielectric segment, said gate stack comprising sidewalls;

utilizing a nitrogen plasma to nitridate said sidewalls of said gate stack.

16. The method of claim 15 wherein said step of utilizing said nitrogen plasma to nitridate said sidewalls of said gate stack causes nitrogen to enter said high-k dielectric segment, said nitrogen forming an oxygen diffusion barrier in said high-k dielectric segment.

17. The method of claim 15 wherein said step of etching said gate electrode layer and said high-k dielectric layer to form said gate stack is performed in a process chamber, said process chamber being utilized to perform said step of utilizing a nitrogen plasma to nitridate said sidewalls of said gate stack.

18. The method of claim 15 wherein said step of etching said gate electrode layer and said high-k dielectric layer to form said gate stack is performed in a first process chamber and said step of utilizing a nitrogen plasma to nitridate said sidewalls of said gate stack is performed in a second process chamber.

19. The method of claim 15 wherein said high-k dielectric segment is selected from the group consisting of hafnium oxide, hafnium silicate, zirconium oxide, zirconium silicate, and aluminum oxide.

20. The method of claim 15 wherein said gate electrode segment comprises polysilicon.